

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE  <b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>		ATTORNEY'S DOCKET NUMBER <b>OKAMOTO7</b>
		U.S. APPLICATION NO. (If known, see 37 CFR 1.5)  <div style="font-size: 1.5em; font-weight: bold; text-align: center;">09/601474</div>
INTERNATIONAL APPLICATION NO. <b>PCT/JP99/00393</b>	INTERNATIONAL FILING DATE <b>29 January 1999</b>	PRIORITY CLAIMED <b>3 February 2000</b>
TITLE OF INVENTION <b>METHOD OF FORMING PROTECTIVE COATING ON CELL SAFETY VALVE ELEMENT...</b>		
APPLICANT(S) FOR DO/EO/US <b>H. OKAMOTO et al.</b>		
<p>Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:</p> <ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</li> <li>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19<sup>th</sup> month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))             <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau)</li> <li>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))             <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol> <p><b>Items 11. to 16. below concern document(s) or information included:</b></p> <ol style="list-style-type: none"> <li>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>12. <input type="checkbox"/> An Assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.  <input checked="" type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</li> <li>14. <input type="checkbox"/> A substitute specification.</li> <li>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>16. <input checked="" type="checkbox"/> Other items or information:             <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Courtesy copy of the first page of the International Publication (WO 99/40637).</li> <li><input checked="" type="checkbox"/> Courtesy copy of the International Preliminary Examination Report. There were no annexes.</li> <li><input checked="" type="checkbox"/> Formal drawings, 8 sheets, Figures 1-8.</li> </ul> </li> </ol>		

U.S. APPLICATION NO (If known, see 37 CFR 1.5) <b>09/601474</b>		International Application No <b>PCT/JP99/00393</b>		Attorney's Docket No. <b>OKAMOTO7</b>	
17. [XX] The following fees are submitted: <b>BASIC NATIONAL FEE (37 CFR 1.492 (a)(1)-(5):</b> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO..... <b>\$970.00</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO..... <b>\$840.00</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO..... <b>\$760.00</b>  International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)..... <b>\$670.00</b>  International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)..... <b>\$96.00</b>  <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>				<b>CALCULATIONS</b> PTO USE ONLY	
Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than [ ] 20 [X] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ 840.00	
Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than [ ] 20 [X] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ 130.00	
Claims as Originally Presented	Number Filed	Number Extra	Rate		
Total Claims	13 - 20	0	X \$18.00	\$ 0	
Independent Claims	7 - 3	4	X \$78.00	\$ 312.00	
Multiple Dependent Claims (if applicable)			+\$260.00	\$	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				\$ 1,282.00	
Claims After Post Filing Prel. Amend	Number Filed	Number Extra	Rate		
Total Claims	20 - 20	0	X \$18.00	\$ 0	
Independent Claims	7 - 7	0	X \$78.00	\$ 0	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				\$ 1,282.00	
Reduction of ½ for filing by small entity, if applicable. A small entity statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28)				\$	
<b>SUBTOTAL =</b>				\$ 1,282.00	
Processing fee of <b>\$130.00</b> for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
<b>TOTAL NATIONAL FEE =</b>				\$ 1,282.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property +				\$	
<b>TOTAL FEES ENCLOSED =</b>				\$ 1,282.00	
				<b>Amount to be:</b>	\$
				<b>refunded</b>	\$
				<b>charged</b>	\$
a. [ ] A check in the amount of \$ _____ to cover the above fees is enclosed. b. [XX] Credit Card Payment Form (PTO-2038), authorizing payment in the amount of \$1,282.00 is attached. c. [ ] Please charge my Deposit Account No. <b>02-4035</b> in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. d. [XX] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <b>02-4035</b> . A duplicate copy of this sheet is enclosed.					
<b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b>					
SEND ALL CORRESPONDENCE TO:					
<b>BROWDY AND NEIMARK, P.L.L.C.</b> <b>624 NINTH STREET, N.W., SUITE 300</b> <b>WASHINGTON, D.C. 20001</b> <b>TEL: (202) 628-5197</b> <b>FAX: (202) 737-3528</b> Date of this submission: <b>August 3, 2000</b>				SIGNATURE	
				Norman J. Latker	
				NAME	
				19,963	
				REGISTRATION NUMBER	

09/601474

534 Rec'd PCT/PTO 03 AUG2000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	Art Unit:
Hiroaki OKAMOTO et al.	)	
	)	
IA No.: PCT/JP99/00393	)	
	)	Washington, D.C.
IA Filed: January 29, 1999	)	
	)	
U.S. App. No.:	)	
(Not Yet Assigned)	)	
	)	August 3, 2000
National Filing Date:	)	
(Not Yet Received)	)	
	)	
For: METHOD OF FORMING...	)	Docket No.: OKAMOTO7

PRELIMINARY AMENDMENT

Honorable Commissioner of Patents and Trademarks  
Washington, D.C. 20231

Sir:

Contemporaneous with the filing of this case and  
prior to calculation of the filing fee, kindly amend as  
follows:

IN THE SPECIFICATION

After the title please insert the following  
paragraph:

--CROSS REFERENCE TO RELATED APPLICATION

The present application is the national stage under  
35 U.S.C. 371 of PCT/JP99/00393, filed January 29, 1999. --

IN THE CLAIMS

Claim 8, lines 1-2, delete "or 7".

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Claim 10, line 2, delete "any of claim 6 to 9", and insert therefor --claim 6--.

Claim 12, line 1, delete "or 11".

Claim 13, line 5, delete "any of claim 10 to 12", and insert therefor --claim 10--.

If, inadvertently, a proper multiple dependent claim has not been amended to reduce it to single dependency, please amend it to be dependent solely on the first-mentioned claim, or, if that is not possible, please cancel the claim and notify the undersigned.

REMARKS

The above amendments to the claims are being made in order to eliminate multiple dependency and for the purpose of reducing the filing fee. Please enter this amendment prior to calculation of the filing fee in this case.

Favorable consideration and allowance are earnestly solicited.

Respectfully submitted,  
BROWDY AND NEIMARK, P.L.L.C.  
Attorneys for Applicant

By: 

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09/601474

534 Rec'd PCT/PTC 03 AUG2000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	Art Unit:
Hiroaki OKAMOTO et al.	)	
	)	
IA No.: PCT/JP99/00393	)	
	)	Washington, D.C.
IA Filed: January 29, 1999	)	
	)	
U.S. App. No.:	)	
(Not Yet Assigned)	)	
	)	August 3, 2000
National Filing Date:	)	
(Not Yet Received)	)	
	)	
For: METHOD OF FORMING...	)	Docket No.: OKAMOTO7

SUPPLEMENTAL PRELIMINARY AMENDMENT

Honorable Commissioner of Patents and Trademarks  
Washington, D.C. 20231  
Sir:

Prior to examination upon the merits, kindly amend as follows:

IN THE CLAIMS

Please add the following claims:

--14. A safety valve element for a battery according to claim 7, wherein said protection film is a coated film of organic coating.

--15. A safety valve element of a battery according to claim 14, wherein said protecting film is a laminated film of an organic resin film.

--16. A closing plate according to claim 11, wherein said adhering means is laser beam welding.

--17. A closed battery, wherein an electrode comprising a positive electrode, a negative electrode and a separator is packed with electrolyte into a battery container and opening portion of said battery container is closed so that said a closing plate for battery according to claim 16 is put into and fixed around inner circumference of said opening portion of said battery container.

--18. A closed battery, wherein an electrode comprising a positive electrode, a negative electrode and a separator is packed with electrolyte into a battery container and opening portion of said battery container is closed so that said a closing plate for battery according to claim 11 is put into and fixed around inner circumference of said opening portion of said battery container.

--19. A closing plate, wherein said safety valve element for a battery according to claim 8 is applied on a closing plate for a battery container having a perforated pore which is to be a valve opening of a safety valve so that said perforated pores of said metal substrate of safety valve element for a battery and said perforated pore of said closing plate are connected through, and said metal substrate and said closing plate are adhered together using adhering means so that both adhere around said perforated pore of said closing plate.

--20. A closing plate, wherein said safety valve element for a battery according to claim 9 is applied on a closing plate for a battery container having a perforated pore which is to be a valve opening of a safety valve so that said perforated pores of said metal substrate of safety valve element for a battery and said perforated pore of said closing plate are connected through, and said metal substrate and said closing plate are adhered together using adhering means so that both adhere around said perforated pore of said closing plate.--

REMARKS

Claims 1-20 presently appear in this case. The above amendments to the claims are being made in order to add new claims and to restore at least partly the varying scope of claims which was eliminated by the elimination of multiple dependencies in the claims.

Favorable consideration is earnestly solicited.

Respectfully submitted,

BROWDY AND NEIMARK, P.L.L.C.  
Attorneys for Applicant

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Specification

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A method of forming a protection film for a safety valve element, a safety valve element which is coated with a protection film, a closing plate for battery using same and a closed battery using same

#### INDUSTRIAL FIELD

The present invention relates to a method of forming a protection film of a safety valve element, a safety valve element covered with a protection film, and a battery using same which prevents from corrosion of a metal part of a safety valve element used for bursting-proof of a closed battery.

#### BACKGROUND OF THE INVENTION

A closed battery using an alkali metal like lithium as a material for positive and negative electrode has been widely used in recent years. These batteries need sealed structure so that an alkali metal like lithium may not react with moisture in an atmosphere, but a completely closed structure sometimes causes a bursting of battery provoked abnormally elevated pressure in the battery when the battery is exposed to high temperature or it is inappropriately handled at the charge or discharge.

It is disclosed that a closing plate for a battery provided with a bursting-proof mechanism or a safety valve for releasing a pressure in a battery when it is abnormally elevated.

For example, Japanese Patent Laid-open Publication No.HEI-5-84025 discloses a safety valve device for a closed battery which provide a gas releasing opening in a positive electrode termi-

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nal constituting a closing plate for a battery and a metal foil welded for bursting-proof.

In this closing plate for a battery, when a pressure in a battery is elevated, a metal foil for bursting-proof ruptures so that a pressure releases through a gas releasing opening applied in a positive electrode terminal.

When electrolyte is filled up in a battery container, electrolyte sometimes scatters and adheres the outside of it. Especially, in case of lithium ion battery, a non-aqueous electrolyte including lithium fluoride as a supporting electrolyte is used for electrolyte.

This fluoride does not attack a metal part of a battery container and a safety valve, but it has strong corrosion so as to absorb moisture in atmosphere and to change into hydrofluoric acid.

For this reason, it is a problem that an electrolyte scatters and adhere an outside of a battery container, especially a metal a foil of a safety valve element, and that a thin metal foil is perforated by corrosion.

The present invention provides a method of forming a protection film of a safety valve element for a closed battery, a safety valve element covered by a protect film, a closing plate using same and a closed battery using same which prevents from corrosion of a metal part by covering the safety valve element for battery by a protection film.

#### DISCLOSURE OF THE INVENTION

The present invention is a method of forming a protection film of a safety valve element for a battery comprising a metal sub-

strate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein an organic coating is coated on at least one side of it.

Further, it is a method of forming a protection film of a safety valve element of a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein an organic resin film is laminated on at least one side of it.

Furthermore, it is a method of forming a protection film of a safety valve element of a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein an organic coating is coated on at least one side of covering portions of said metal foil.

Further, it is a method of forming a protection film of a safety valve element for a battery, wherein an organic coating is coated on a safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores after said safety valve element for a battery is applied on a closing plate for a battery container having a perforated pore which is to be a valve opening of a safety valve so that said perforated pores of said metal substrate of safety valve element for a battery and said perforated pore of said closing plate are connected through, and said metal substrate and said closing plate are adhered together using adhering means so that both adhere around said perforated pore of said closing plate, and it is characterized that said means is laser beam welding.

Further, the present invention is a safety valve element for

a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal so as to cover said perforated pores, wherein a protection film is covered on at least one side of said safety valve element for a battery.

It is characterized that said protection film is a coated film of an organic coating or a laminated film of an organic resin film.

Further, it is a safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein a protection film is covered on at least one side of covering portions of said metal foil of a safety valve element for a battery, and it is characterized that said protection film is a coated film of an organic coating.

Further, the present invention is a closing plate, wherein said safety valve element for a battery according to any of claim 6 to 9 is applied on a closing plate for a battery container having a perforated pore which is to be a valve opening of a safety valve so that said perforated pores of said metal substrate of safety valve element for a battery and said perforated pore of said closing plate are connected through, and said metal substrate and said closing plate are adhered together using adhering means so that both adhere around said perforated pore of said closing plate, or a closing plate, wherein said safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores is applied on a closing plate for a battery container having a perforated pore which is to be a valve opening of a safety valve so that said perforated

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pores of said metal substrate of safety valve element for a battery and said perforated pore of said closing plate are connected through, and said metal substrate and said closing plate are adhered together using adhering means so that both adhere around said perforated pore of said closing plate, and after that an organic coating is coated on said safety valve element for a battery, and it is characterized that said adhering means is laser beam welding.

Furthermore, the present invention is a closed battery, wherein an electrode comprising a positive electrode, a negative electrode and a separator is packed with electrolyte into a battery container and an opening portion of said battery container is closed so that said a closing plate for battery according to any of claim 10 to 12 is put into and fixed around inner circumference of said opening portion of said battery container.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is schematic sectional view showing an example of a safety valve element covered by protection film of the present invention.

Fig. 2 is schematic sectional view showing the other example of a safety valve element covered by protection film of the present invention.

Fig. 3 is schematic sectional view showing another example of a safety valve element covered by protection film of the present invention.

Fig. 4 is schematic sectional view showing an example of a closing plate of a battery having a safety valve element adhered to it.

Fig. 5 is schematic sectional view showing the other example of a closing plate of a battery having a safety valve element adhere to it.

Fig. 6 is schematic sectional view showing another example of a closing plate of a battery having a safety valve element adhere to it.

Fig. 7(a) is schematic sectional view showing an example of a closing plate of a battery having a safety valve element adhered to it before it is covered by a protection film.

Fig. 7(b) is schematic sectional view showing an example of a closing plate of a battery having a safety valve element adhered to it after it is covered by a protection film.

Fig. 8 is schematic sectional view showing another example of a closing plate of a battery having a safety valve element adhere to it.

#### BEST MODE FOR CARRYING OUT THE INVENTION

The examples of a safety valve coated with a protection film and a method of making a protection film of the present invention are now explained below with reference to drawings.

(Example 1)

Fig. 1 and Fig. 2 are sectional views which show the examples of a safety valve element coated with a protection film of the present invention.

As shown in Fig. 1, a safety valve element 10 is provided with a protection film 3 formed on a metal foil 2 of a laminated board 5 which is laminated with metal foil 2 so as to cover perforated pore 4 on one side of a metal substrate 1 having perforated pore 4 which is to be an opening of a safety valve.

As shown in Fig. 2, a safety valve element is provided with a protection film 3 formed on a metal substrate 1, a side wall portion of perforated pore 4 and a portion where metal foil 2 covers perforated pore 4.

That is, a protection film 3 covers all around cavity which is composed of metal foil 2 and perforated pore 4 formed on a metal substrate 1 and connects with a protection film 3 covering a metal substrate 1.

As examples are shown in Fig. 1 and Fig. 2, a protection film 3 is formed at least on the whole surface to be the outside of safety valve element 10 in a battery container.

Each safety valve element 10 of the present invention is produced as follows.

At first, a strip of laminate 5 is produced by laminating metal foil 2 on one side of a strip of metal substrate 1 having plural numbers of perforated pore 4 to be the opening of valve so as to cover the perforated pore 4.

Though perforated pore 4 is usually circle having a diameter of 1 to 10 mm, it may be oval having major axis of 1 to 10 mm or polygon having same size of the circle with said diameter.

Further, a form of perforated pore 4 can be a segment having a certain width ( for example, straight or curved slit etc.) or geometric pattern combined with said figures.

It is preferable that perforated pore 4 is geometrically arranged in such a pattern of lattice, zigzag or a like, and pitch of each perforated pore 4 is properly selected by the required size of a safety valve material.

Perforated pore 4 can be formed from a thin cold-rolled

metal sheet by usual perforating method such as punching press or etching.

Metal substrate 1 forming perforated pore 4 as mentioned above and metal foil 2 are cold-pressure-bonded in a vacuum using a method for example disclosed in Japanese Patent Laid-open Publication No. HEI-1-224184.

That is, after activating a surface of a metal substrate 1 and a metal foil 2 to be laminated each other by spattering in etching chamber, they are cold-pressure-bonded using a rolling unit in a vacuum chamber.

Thus, a strip of laminate 5 of the present invention is produced.

In an example shown in Fig. 1, a protection film 3 is formed by coating and subsequent drying or baking an organic resin coating on whole surface of a metal foil 2 of a strip of laminate 5 produced as mentioned above.

Further, a protection film 3 is formed by laminating an organic resin film on whole surface of metal foil 2 of a strip of laminate 5.

In this way, a strip of laminate covered by protection film wherein plural numbers of perforated pore 4 formed on a metal substrate 1 are covered by metal foil 2 and protection film 3.

A lot of safety valve elements 10 for battery can be obtained from a strip of laminate covered by a protection film by punching in such a manner that at least one perforated pore is included in each safety valve element.

In an example shown in Fig. 2, a protection film 3 is formed by coating and subsequent drying or baking an organic resin coating

on the whole surface of the side which is a metal substrate 1 of a strip of laminate 5, a side wall portion of perforated pore 4 formed on a metal substrate 1 and a portion where metal foil 2 covers perforated pore 4.

Coating is carried out by spraying or dripping a liquid coating into perforated pore.

In this way, a strip of laminate covered by a protection film wherein plural numbers of perforated pore 4 formed on metal substrate are covered by metal foil 2 and metal substrate 7 and a side wall portion and bottom portion of perforated pore 4 are covered by protection film 3.

A lot of safety valve elements 10 for battery can be obtained from a strip of laminate covered by protection film by punching in such a manner that at least one perforated pore is included in each safety valve element.

Said metal substrate is preferably any of steel sheet, stainless steel sheet, copper sheet and aluminum sheet.

The sheet thickness is usually 0.03 to 0.50 mm from the point of view of strength, economy and adhesion to a closing plate for battery container and 0.05 to 0.10 mm is more preferable.

A safety valve element for battery of the present invention aims to operate at a low pressure 30 kgf/cm<sup>2</sup> or less, preferably 20 kgf/cm<sup>2</sup> or less.

Therefore, the thickness of a metal foil of the present invention is preferably 5 to 50  $\mu$ m.

If the thickness is 5  $\mu$ m or less, it easily fractures by an impact like a fall when it is applied to a safety valve for battery or like.



On the other hand, if the thickness is  $50\text{ }\mu\text{m}$  or more, it is not fractured by a pressure of  $30\text{ kgf/cm}^2$  or less even when a metal having a small tensile strength is applied, but fractured only when high pressure is loaded, a battery container itself burst, fragments scatter, and electrolyte sputter out scatters, which causes damage of safety declines and disadvantage of cost.

Metal foil is preferably any of steel foil, stainless steel foil, copper foil, aluminum foil, nickel foil and nickel-iron alloy foil.

Further, it is possible to use every metal foil as long as it is stable against electrolyte which is filled in a battery container, and it is not corroded and a large amount of reacted gases is not generated.

It is possible to use metal foil of zinc, lead, copper alloy such as brass, bronze, phosphor bronze, gun metal or monel, aluminum alloy such as duralumin and so on in addition to the above metal foils.

Above mentioned organic resin coating is preferably coating of fluorine contained resin, epoxy resin, vinyl resin, urethane resin, polyester resin and acrylic resin, which is coated by any of spray coating, roll coating, bar coating and brush coating and so on.

Further, said organic resin film is preferably film which is produced from any of polyolefin resin, polyester resin, polyamide resin, polycarbonate resin and poly vinyl chloride resin.

Those resin films are directly adhered to be above mentioned laminate by thermally melt-bonding or stucked to be it by interposing primer.

The thickness of those organic resin coating or film is preferably  $1\text{ to }30\text{ }\mu\text{m}$ , more preferably  $5\text{ to }20\text{ }\mu\text{m}$ .

If the thickness is  $1\ \mu\text{m}$  or less, it is difficult to completely coat metal foil of a coating foundation in the case of coating, and it is very difficult to make film in the case of a resin film. On the other hand, if the thickness is  $30\ \mu\text{m}$  or more, it is not fractured at a prescribed loading pressure but fractured only when a loading pressure exceeding the prescribed fracturing pressure is loaded, which causes damage of safety and disadvantage of cost.

(Example 2)

Fig. 3 is a sectional views showing another example of a safety valve element for battery covered by a protection film of the present invention.

As shown in Fig. 3, a safety valve element 10 of the present invention can be provided with a protection film 3 in such a manner that an organic resin is dripped and dried for solidifying at portion 4a of metal foil 2 where metal foil 2 covers perforated port 4 formed on laminates composed of metal substrate 1 having perforated pore 4 which is to be the opening of safety valve covered by metal foil 2 so as to close perforated pore 4.

(Example 3)

The produced safety valve element 10 of the present invention is shown in Fig. 4~ Fig. 6. The perforated pore 4 of a metal substrate 1 of a safety valve element 10 and perforated pore 7 of a closing battery 6 for battery container is put together so as to overlap both, and then a safety valve element 10 is adhered by a method of laser beam welding a round perforation 7.

Fig 4 show the case that a safety valve element having a structure shown in Fig. 1 is adhered to a closing plate for a battery container.

Fig. 5 and Fig. 6 show the case that a safety valve element having a structure shown in Fig. 2 and Fig. 3, respectively is adhered to a closing plate of a battery.

The method of adhering is not only said laser beam welding but also any method of adhering using adhesive such as thermosetting resin adhesive and thermoplastic resin adhesive and rubber adhesive as long as necessary adhering strength is obtained.

Though Fig. 4~Fig. 6 show the case of adhesion that one of perforated pore 7 of a closing plate 6 for a battery and one of perforated pore 4 of a metal substrate 1 of a safety valve element 10 are connected through so as to overlap both pores and then both is adhered, but it is possible that one of perforated pore of a closing plate 6 for a battery and plural numbers of perforated pore 4 of a metal substrate 1 of a safety valve element 10 are connected through so as to overlap both pores and then both is adhered.

Said closing plate is preferably any of the same steel sheet, stainless steel sheet, copper sheet, aluminum sheet as above mentioned metal substrate.

Thickness of a sheet is usually 0.03 to 0.50 mm from point of view of strength, economy and easiness of adhering to a closing plate of a battery, and 0.05 to 0.10 mm is more preferable.

(Example 4)

Further, as shown in Fig. 7(a) and Fig. 7(b), a closing plate for a battery container to which a safety valve element for a battery covered by a protection film of the present invention can also be produced.

After a perforated pore 4 of a metal substrate 1 of a safety valve element 10 and a perforation 7 of a closing plate 6 of a battery

container is put together so as to be overlapped, both are glued by a method of a laser beam welding around a perforation 7 as shown in Fig. 7(a).

As shown in Fig. 7(b), there can be provided a protection film 3 consisting of an organic coating on a safety valve element of a battery which include a weld part.

Like this, because a protection film is coated on both a metal foil which blockades perforation and a naked metal part of a safety valve element welded by a laser beam, a metal part cannot be attacked in whenever corrosive electrolyte adheres.

(Example 5)

Though Fig. 4~Fig. 7 show structures of that perforated pore 4 of overlapping a perforated metal substrate 1 of a safety valve element 10 and perforation 7 of a closing plate 6 so as to put in and glue a safety valve element 10 whose diameter is equal to that of perforated pore 7 of a closing plate 6 to perforated pore 7 of a closing plate 6, it is possible to pile and glue a safety valve element 10 whose diameter is bigger than that of perforated pore 7 to a closing plate 6

A closing plate of a battery which adhere a safety valve element coated with a protection film blockade a opening of said battery container which electrode support to put in with electrolyte and a closing battery of the present invention is made.

#### POSSIBILITY OF USE IN INDUSTRY

The present invention is a method of forming a protection film of a safety valve element of a battery and a safety valve element using it.

There is provided a protection film of safety valve element coated with an organic coating or a film of an organic resin at least one side of a safety valve element which consist of a perforated metal substrate and a metal foil laminated on said perforated substrate so as to blockade said perforation.

Further, the present invention is a closing plate for a closed battery characterized that the closing plate for a battery container having a perforated pore which is to be the opening of valve and the metal substrate of the safety valve element for a battery are attached each other in such a manner that the perforated pore of the metal substrate and the perforated pore of the closing plate are connected through, and then both is adhered around the perforated pore of the closing plate using adhering means.

Furthermore, the present invention is a closed battery characterized that an electrode comprising a positive electrode, a negative electrode and a separator is packed with electrolyte into a battery container and an opening portion of the battery container is closed so that the closing plate for battery is put into and fixed around inner circumference of the opening portion of the battery container.

A closed battery using a closing plate of the present invention contains a lithium fluoride as a supporting electrolyte, and metallic materials comprising a battery container and safety valve element are not corroded. But the fluoride absorbs moisture in the atmosphere and change into hydrofluoride acid which has strong corrosion. When non aqueous electrolyte having such a strong corrosion scatters and sticks to the outside of a battery container, a metal foil of a safety valve element, in particular, the thin metal foil is

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Year	Country	Population (millions)	Urban population (millions)	Urban population (%)	Population density (per sq km)	Urban population density (per sq km)	Population growth rate (%)	Urban population growth rate (%)	Population growth rate (per 1,000)	Urban population growth rate (per 1,000)	Population growth rate (per 1,000)	Urban population growth rate (per 1,000)
1950	United States	150	100	66.7	30	100	1.2	1.2	12	12	12	12
1955	United States	155	105	67.7	31	105	1.3	1.3	13	13	13	13
1960	United States	160	110	68.8	32	110	1.4	1.4	14	14	14	14
1965	United States	165	115	69.7	33	115	1.5	1.5	15	15	15	15
1970	United States	170	120	70.6	34	120	1.6	1.6	16	16	16	16
1975	United States	175	125	71.4	35	125	1.7	1.7	17	17	17	17
1980	United States	180	130	72.2	36	130	1.8	1.8	18	18	18	18
1985	United States	185	135	72.9	37	135	1.9	1.9	19	19	19	19
1990	United States	190	140	73.7	38	140	2.0	2.0	20	20	20	20
1995	United States	195	145	74.4	39	145	2.1	2.1	21	21	21	21
2000	United States	200	150	75.0	40	150	2.2	2.2	22	22	22	22
2005	United States	205	155	75.6	41	155	2.3	2.3	23	23	23	23
2010	United States	210	160	76.2	42	160	2.4	2.4	24	24	24	24
2015	United States	215	165	76.7	43	165	2.5	2.5	25	25	25	25
2020	United States	220	170	77.3	44	170	2.6	2.6	26	26	26	26
2025	United States	225	175	77.8	45	175	2.7	2.7	27	27	27	27
2030	United States	230	180	78.3	46	180	2.8	2.8	28	28	28	28
2035	United States	235	185	78.7	47	185	2.9	2.9	29	29	29	29
2040	United States	240	190	79.2	48	190	3.0	3.0	30	30	30	30
2045	United States	245	195	79.6	49	195	3.1	3.1	31	31	31	31
2050	United States	250	200	80.0	50	200	3.2	3.2	32	32	32	32
2055	United States	255	205	80.4	51	205	3.3	3.3	33	33	33	33
2060	United States	260	210	80.8	52	210	3.4	3.4	34	34	34	34
2065	United States	265	215	81.1	53	215	3.5	3.5	35	35	35	35
2070	United States	270	220	81.5	54	220	3.6	3.6	36	36	36	36
2075	United States	275	225	81.8	55	225	3.7	3.7	37	37	37	37
2080	United States	280	230	82.1	56	230	3.8	3.8	38	38	38	38
2085	United States	285	235	82.5	57	235	3.9	3.9	39	39	39	39
2090	United States	290	240	82.8	58	240	4.0	4.0	40	40	40	40
2095	United States	295	245	83.1	59	245	4.1	4.1	41	41	41	41
2100	United States	300	250	83.3	60	250	4.2	4.2	42	42	42	42

## Claims

1. A method of forming a protection film of a safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein an organic coating is coated on at least one side of it.
2. A method of forming a protection film of a safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein an organic resin film is laminated on at least one side of it.
3. A method of forming a protection film of a safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein an organic coating is coated on at least one side of covering portions of said metal foil.
4. A method of forming a protection film of a safety valve element for a battery, wherein an organic coating is coated on a safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores after said safety valve element for a battery is applied on a closing plate for a battery container having a perforated pore which is to be a valve opening of a safety valve so that said perforated pores of said metal substrate of safety valve

element for a battery and said perforated pore of said closing plate are connected through, and said metal substrate and said closing plate are adhered together using adhering means so that both adhere around said perforated pore of said closing plate.

5. A method of forming a protection film of a safety valve element for a battery according to claim 4, wherein said adhering means is laser beam welding.

6. A safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein a protection film is covered on at least one side of said safety valve element for a battery.

7. A safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores, wherein a protection film is covered on at least one side of covering portions of said metal foil of a safety valve element for a battery.

8. A safety valve element for a battery according to claim 6 or 7, wherein said protection film is a coated film of an organic coating.

9. A safety valve element of a battery according to claim 6, wherein said protecting film is a laminated film of an organic resin film.



10. A closing plate, wherein said safety valve element for a battery according to any of claim 6 to 9 is applied on a closing plate for a battery container having a perforated pore which is to be a valve opening of a safety valve so that said perforated pores of said metal substrate of safety valve element for a battery and said perforated pore of said closing plate are connected through, and said metal substrate and said closing plate are adhered together using adhering means so that both adhere around said perforated pore of said closing plate.

11. A closing plate, wherein said safety valve element for a battery comprising a metal substrate having perforated pores and a metal foil laminated on said metal substrate so as to cover said perforated pores is applied on a closing plate for a battery container having a perforated pore which is to be a valve opening of a safety valve so that said perforated pores of said metal substrate of safety valve element for a battery and said perforated pore of said closing plate are connected through, and said metal substrate and said metal closing plate are adhered together using adhering means so that both adhere around said perforated pore of said closing plate, and after that an organic coating is coated on said safety valve element for a battery.

12. A closing plate according to claim 10 or 11, wherein said adhering means is laser beam welding.

13. A closed battery, wherein an electrode comprising a posi-

tive electrode, a negative electrode and a separator is packed with electrolyte into a battery container and opening portion of said battery container is closed so that said a closing plate for battery according to any of claim 10 to 12 is put into and fixed around inner circumference of said opening portion of said battery container.

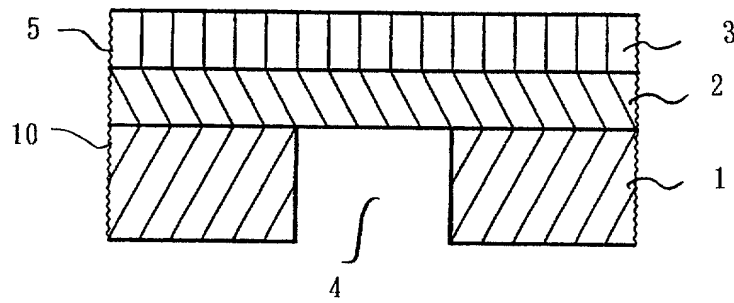
ABSTRACT

The present invention provide a method of forming a protection film of a safety valve element for battery which prevents from corroding a metal portion by covering protection film on the safety valve element for battery, a closing plate for a battery using same and a closed battery using same.

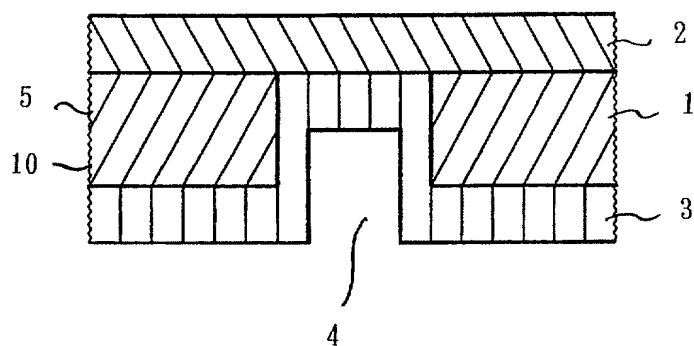
A safety valve element of the present invention is composed of a safety valve element 10 comprising a metal substrate 1 having a perforated pore 4 and a metal foil 2 laminated on a metal substrate 1 so as to cover perforated pore 4 and a protection film 3 which is formed by coating an organic coating at least on one side of a safety valve element 10. Further, a closing plate puts a safety valve element 10 to provide a protection film 3 which is coated with organic film on a closing plate 6 of battery container to provide perforation 4 which is an opening of a safety valve so as to face perforations of a metal substrate 4 and perforation of a closing plate 7 and then to glue around perforation of a closing plate 7, and a closing plate of a battery is made. Furthermore, there is closed an opening of a battery container that fixes electrode which consist of positive electrode, negative electrode and separator, and a closed battery is made.

Elected drawing: Fig. 1

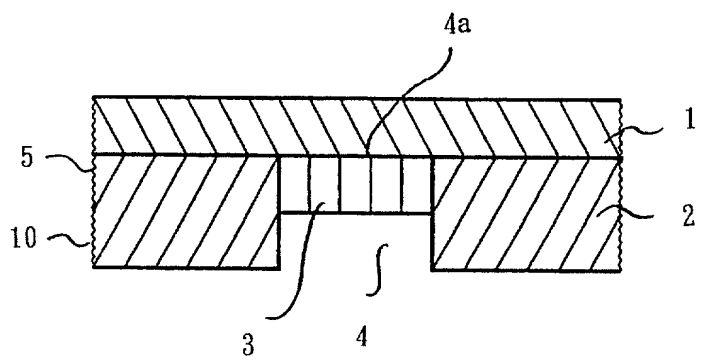
F i g . 1



F i g . 2

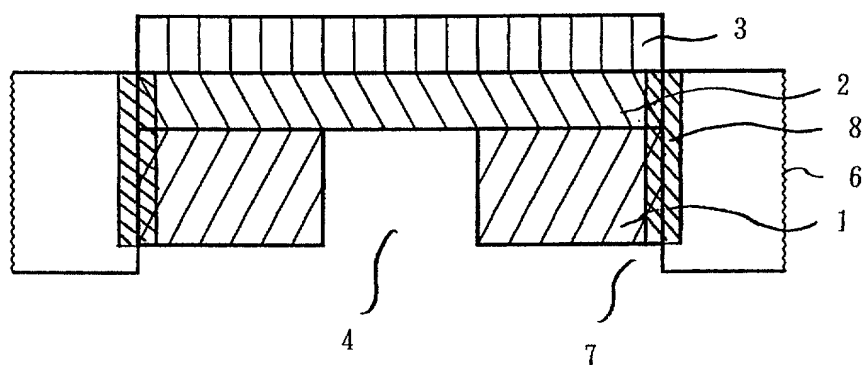


F i g. 3



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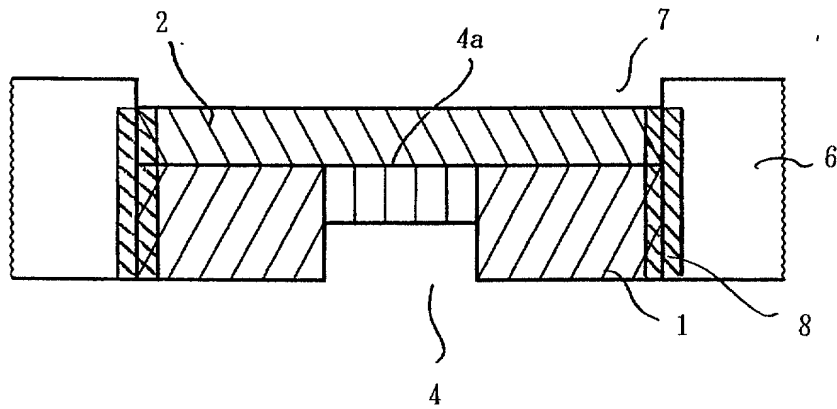
F i g . 4



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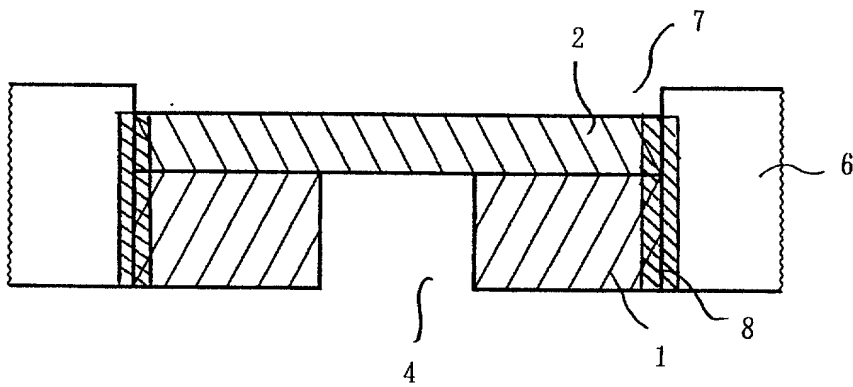
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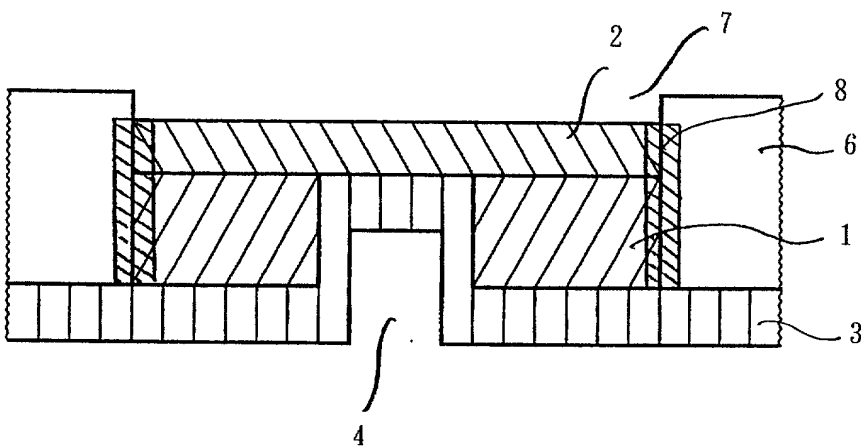
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F i g. 7

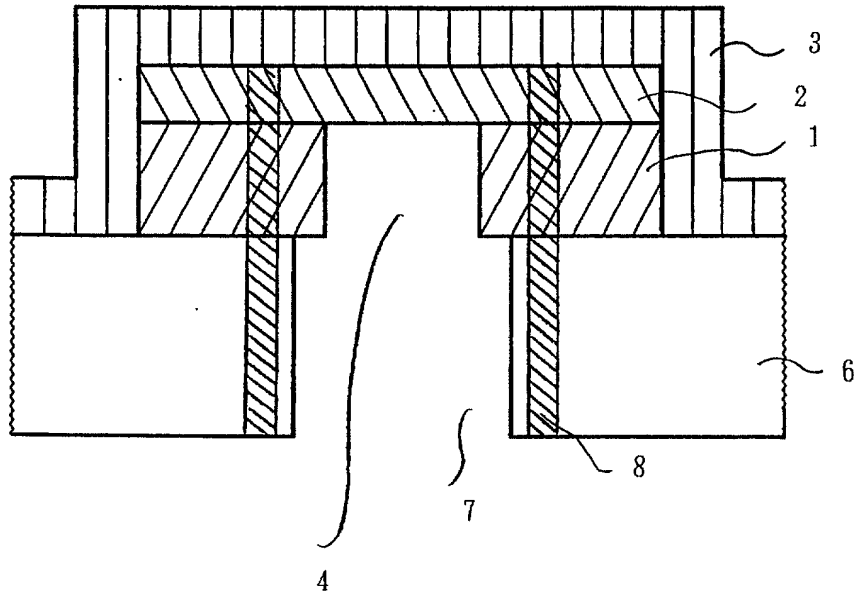
(a)



(b)



F i g. 8



Page 1 of 2 Pages [x] Original [ ] Substitute [ ] Supplemental Atty. Docket: OKAMOTO7

### Combined Declaration for Patent Application and Power of Attorney

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; and that I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD OF FORMING PROTECTIVE COATING ON CELL SAFETY VALVE ELEMENT, CELL SAFETY VALVE ELEMENT COATED WITH PROTECTIVE FILM, CELL SEALING PLATE USING THE ELEMENT, AND ENCLOSED CELL USING THE PLATE

the specification of which (check one)

- [ ] is attached hereto;  
[ ] was filed in the United States under 35 U.S.C. §111 on \_\_\_\_\_, as U.S. Appl. No. \_\_\_\_\_; or  
[X] was/will be filed in the U.S. under 35 U.S.C. §371 by entry into the U.S. national stage of an international (PCT) application, PCT/JP99/00393; filed 29 January 1999; entry requested on 3 August 2000; national stage application received U.S. Appl. No. \_\_\_\_\_; §371/§102(e) date \_\_\_\_\_ (\* if known)

and was amended on 3 August 2000 (if applicable).

(Include dates of amendments under PCT Art. 19 and 34 if PCT)

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above; and I acknowledge the duty to disclose to the Patent and Trademark Office (PTO) all information known by me to be material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §§ 119 and 365 of any prior foreign application(s) for patent or inventor's certificate, or prior PCT application(s) designating a country other than the U.S., listed below with the "Yes" box checked and have also identified below any such application having a filing date before that of the application on which priority is claimed:

<u>10/35371</u> (Number)	<u>Japan</u> (Country)	<u>3 February 1998</u> (Day Month Year Filed)	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> YES <input type="checkbox"/> NO
_____ (Number)	_____ (Country)	_____ (Day Month Year Filed)	<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> YES <input type="checkbox"/> NO

I hereby claim the benefit under 35 U.S.C. §120 of any prior U.S. non-provisional application(s) or prior PCT application(s) designating the U.S. listed below, or under §119(e) of any prior U.S. provisional applications listed below, and, insofar as the subject matter of each of the claims of this application is not disclosed in such U.S. or PCT application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose to the PTO all information as defined in 37 C.F.R. §1.56(a) which occurred between the filing date of the prior application and the national filing date of this application:

_____ (Application No.)	_____ (Day Month Year Filed)	_____ (Status: patented, pending, abandoned)
_____ (Application No.)	_____ (Day Month Year Filed)	_____ (Status: patented, pending, abandoned)
_____ (Application No.)	_____ (Day Month Year Filed)	_____ (Status: patented, pending, abandoned)

As a named inventor, I hereby appoint the following registered practitioners to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

All of the practitioners associated with Customer Number 001444

Direct all correspondence to the address associated with Customer Number 001444, i.e.,

**BROWDY AND NEWMARK, P.L.L.C.**  
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(202) 628-5197

The undersigned hereby authorizes the U.S. Attorneys or Agents appointed herein to accept and follow instructions from OHTA PATENT OFFICE as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. Attorneys or Agents and the undersigned. In the event of a change of the persons from whom instructions may be taken, the U.S. Attorneys or Agents appointed herein will be so notified by the undersigned.

Page 2 of 2 Pages

Atty. Docket: OKAMOTO7

Title: METHOD OF FORMING PROTECTIVE COATING ON CELL SAFETY VALVE ...U.S. Application filed \_\_\_\_\_, Serial No. \_\_\_\_\_  
PCT Application filed \_\_\_\_\_, Serial No. \_\_\_\_\_

I hereby further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			
FULL NAME OF SEVENTH JOINT INVENTOR		INVENTOR'S SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			